series, as compared with Dr. Bastian's already recorded results, were due to the fact that the material used consisted partly of rind. Dr. Bastian thought that this might be the case, and accordingly another infusion was prepared in which no rind was employed. As before, the fresh acid infusion of turnip was divided into two parts, one of which was neutralised by liquor potassæ. Of four retorts, three were charged with unneutralised liquid, the fourth with neutral. Of the three, two were treated with cheese; to the third no addition was made. They were prepared in every respect as before. In each case the drawing-in of the glass in the blowpipe flame was again noticed before the neck of the retort was broken.

(*a.*) *Unneutralised infusion with cheese.*—This infusion showed opalescence, even after twenty-four hours. On the 23rd it had become decidedly turbid, and was opened. The liquid was fœtid, and its reaction acid. It swarmed with Bacteria.

(*b.*) *The same.*—The retort was opened on the 31st, its contents having shown a slight turbidity for several days previously. The liquid was slightly fœtid, and it contained characteristic Bacteria, which, however, were few in number.

(*c.*) *Neutral infusion without cheese.*—The retort was opened on Dec. 31, the fluid having been slightly turbid for several days. The liquid was acid, and slightly fœtid, but still retained the odour of turnip. A drop contained a few Bacteria, about 0·003 mm. in length, which exhibited oscillatory movements.

(*d.*) *Unneutralised infusion without cheese.*—The liquid contained a white mass which lay at the bottom, and was so tenacious that it could be drawn out into strings with needles. This consisted entirely of Bacteria and Leptothrix, embedded in a hyaline matrix. There were also Bacteria in the liquid.

THIRD SERIES—(Dec 27th.)

It appeared to me desirable to ascertain whether the condition of the internal surface of the glass vessels exercised any influence on the result. I therefore heated two retorts to 250° C., keeping them at that temperature for half an hour, and closed them while hot in the blow-pipe flame. These Dr. Bastian charged by breaking off their points under the surface of a neutral infusion of turnip with cheese, freshly prepared for the purpose, without employing any of the rind. The retorts were boiled and sealed in the same way as before, excepting that whereas one was boiled only five minutes the other was boiled ten minutes. The specific gravity of the infusion used was 1013. A third uncalcined retort was charged with some of the same infusion containing no cheese. This was also boiled for ten minutes.

I was out of town from the 28th to the 30th, and therefore did not examine the retorts until the 31st. Dr. Bastian informed me that on the 28th, twenty-one hours after preparation, the liquids in both the calcined retorts were distinctly turbid, the temperature of the water bath being 32° C.: and that sixty-six hours after preparation, whilst the turbidity was much more marked, each flask also contained what appeared to be a "pellicle," which had formed and sunk. At this period the fluid in the third flask had also become very decidedly turbid.

(*a.*) *Neutral turnip infusion with cheese in calcined retort, boiled ten minutes.*—The retort having been tested in the way previously described, was opened on the 31st. The liquid was very fœtid, had an acid reaction, and contained much scum. It was found to be full of Bacteria, whilst Leptothrix existed in abundance in portions of the scum, together with granules of various sizes which refracted light strongly.

(*b.*) *The same boiled five minutes.*—The state of the liquid was the same as that just described.

(*c.*) *Neutral infusion without cheese, boiled ten minutes—retort not calcined.*—In this liquid the rods and filaments were much less numerous. In other respects its characters were the same.

In each case before opening the retort it was again observed that a portion of its neck became drawn in when exposed to the blow-pipe flame.

As regards the results of the foregoing experiments, it is unnecessary for me to say anything as to their bearing on the question of heterogenesis. The subject has already been frequently discussed in your columns.

The accuracy of Dr. Bastian's statements of fact, with reference to the particular experiments now under consideration, has been publicly questioned. I myself doubted it, and expressed my doubts, if not publicly, at least in conversation. I am content to have established—at all events to my own satisfaction—that, by following Dr. Bastian's directions, infusions can be prepared which are not deprived, by an ebullition of from five to ten minutes, of the faculty of undergoing those chemical changes which are characterised by the presence of swarms of Bacteria, and that the development of these organisms can proceed with the greatest activity in hermetically-sealed glass vessels, from which almost the whole of the air has been expelled by boiling.

J. BURDON SANDERSON

University College, Jan. 1

The Recent Star-shower at Sea

IN case no other account should reach you of a meteoric shower witnessed by the officers and military passengers of H. M. troopship *Tamar* on the night of Wednesday, November 27, 1872, I send notes collected from several accounts.

The vessel was at the time about 7° south and 4° west of the Bermudas, in longitude 68° 50′ W., latitude 25° 30′ N. Between 8 and 10 P.M. by one witness, between 10 and 12 P.M. by another, that is, between 12h. and 16h. Greenwich mean time, there was a nearly uninterrupted succession of shooting stars—from all parts of the sky, says one, from about E.N.E. to W.S.W., says another. The gentleman who gives the earlier hour estimates their number as from 25 to 50 per minute; the gentleman who gives the later at about 3 in 2 minutes. They were not counted or accurately observed by any one, but this discrepancy perhaps justifies the belief that the thickest part of the stream was passed through by the earth at the earlier hour. Sunset would have been soon after 5; thus it was dark with no moon before the earliest hour named.

I cannot learn that they were seen in Bermuda; but the weather was cloudy.

J. H. L.

Bermuda, Dec. 17, 1872

Curious Auroral Phenomenon

ON the nights of the 4th and 5th of this month a curious phenomenon, presenting much resemblance to an aurora borealis, was noticed here.

It had the character of a faint, steady light, rather red than yellow, extending over the horizon, which here in that direction is bounded by the sea-line, from N.W. to N.N.E.; while underneath it, that is between it and the horizon, was a rim of dark, smoke-like appearance, such as I have more than once seen in undoubted auroras. The smoky line occupied to a height of about three degrees above the horizon; the light to ten or twelve at most. On both nights it became visible about 9 P.M., and disappeared shortly after 11 P.M.

My house being situated rather more than 300 ft. above the sea and commanding a perfectly open view over it, I had a good opportunity of noticing this appearance: which was also observed and commented on by several other inhabitants of the town. On the night of the 6th I thought I could distinguish something of the kind, but the increasing light of the moon and a sea-fog coming on, rendered the fact uncertain.

The barometer was high, 30° 20″, the wind slight and from the east, the weather cool.

It may be worth adding that the water of the Black Sea being but slightly salt, its phosphorescent phenomena are proportionally insignificant. Hence I do not think that the light in question could have been any way reflected from the sea-surface.

No electrometer or instrument of the kind exists at Trebizond, but the uncomfortable sensations of which many people complained, and, I may add, the abundant sparks from my Tom's back—I ruffled it by way of trial on purpose—seemed to imply

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considerable electric tension in the atmosphere at the time. The weather was also remarkably dry.

Trebizond, Dec. 15, 1872 W. GIFFORD PALGRAVE

The Spectrum of the Aurora and of the Zodiacal Light

UPON a perusal of the chapter in Dr. Schellen's "Spectrum Analysis," specially bearing on the above subjects, I have been led to think—firstly, that our present knowledge of these spectra is far from complete; and secondly, that so far as such knowledge extends, it hardly warrants some of the conclusions arrived at in Dr. Schellen's work. To test the question of the aurora, I have collected, chiefly from the pages of NATURE, a set of observations (excluding a few which gave only rough results), and have arranged them under the heads of the several lines, so that these and their characteristics may be seen at a glance, and the observations compared; and from these observations I deduce the following remarks:—

1. That the full spectrum of the aurora consists of seven bright lines or bands and a faint diffused spectrum.

2. That two (perhaps three) of these lines are sharp and well defined, while the others are more or less nebulous. (As Lord Lindsay notes one of the lines to be sharp on one side and nebulous on the other, it is probable that this, and perhaps others of the nebulous lines, would resolve into groups of lines under higher instrumental power.)

3. That the red line (which seems to have been actually positioned by two observers only) is not found to coincide with the spectrum of any known substance or gas. (*But see next note.*)

4. That the yellow-green aurora line, and perhaps two other lines, according to one observer, coincide with lines of oxygen; while two lines, according to other observers, either fall very near to, or actually coincide with, F and G hydrogen, and that to this extent the axiom of Zöllner, that the spectrum of the aurora does not agree with any of the known spectra of the gases of our atmosphere, is challenged.

6. That Zöllner's theory of the lines or bands in the blue being remains of a continuous spectrum broken up by dark absorption bands, is hardly supported by the other observers.

7. That the aurora spectrum is probably a mixed one, and that the red and yellow-green lines are independent spectra; as also may possibly be the corona line and the continuous spectrum crossed with the fainter lines.

8. That the discrepancies in the observations recorded are considerable, and that all the lines (except, perhaps, Angström's), and specially the red one, require further examination to confirm their position.

And this last proposition I venture to commend to the attention of your spectroscopic correspondents during this winter.

The zodiacal light will also undeniably bear further investigation. The evidence at present seems to strongly incline to the presence of a faint continuous spectrum only. Webb, Backhouse, and Pringle are positive in their observations as to this; and, on the other hand, the bright green line referred to by Dr. Schellen, as seen by Angström and Zöllner *in all parts of the sky* can, as Pringle has well noticed, hardly be assumed to belong conclusively to the zodiacal light, but rather to some faint accompanying aurora. I am not aware whether the zodiacal light and the aurora have been examined with a polariscope. The light, though faint, might, I imagine, be tested with a Nicol's prism and Savart bands. An observation of the zodiacal light in the spring showed me its faint rose-red tint very distinctly, although I was not at that time aware that this tint was characteristic.

AURORA SPECTRUM

No. 1.—*A Line in the Red between C and D*

OBSERVER.	REMARKS.
T. F. (Torquay).	Strong, intermediate in colour and position to lithium and calcium.
J. R. C.	Like lithium line, but duskier; well seen in Browning's miniature spectroscope; sharp and well defined.
BARKER.	Almost equidistant between C and D; wave-length, 623* (C and D being respectively 656 and 589); sharp and well defined; brightness 3 (counting from 1 as brightest).
PROCTOR.	At 24; Ha being 18, and Na 32. Does not coincide with any other line observer has seen.
PIAZZI SMYTH.	Between sodium and lithium, but nearer the latter. Estimated at W.L. 6350.
BACKHOUSE.	Seen in eight auroras, out of thirty-four observed.
ZÖLLNER. (Schellen.)	More refrangible than Ha; possibly lies near the dark telluric lines A; wave-length, 6,279 (Angström).

No. 2.—*A Line in the Yellow Green between D and E (principal auroral line)*

T. F. (Torquay).	Strong; pale yellow near D.
J. R. C.	Sharp and well defined; like principal line in nebulæ, but brighter; a peculiar flickering noticed in the line during the displays of Oct. 1870 and Feb. 1872.
ALVAN CLARK, JUN.	Wave-length, 569. (Probably an error for 559.—J. R. C.)
BARKER.	Wave-length, 562; sharp and well defined; brightness, 1.
PROCTOR.	At 41 (Na being 32); nebulous; absolutely coincident with a line in a lumière tube attributed to oxygen.
LORD LINDSAY.	Sharp and well defined; visible with very narrow slit.
HERSCHEL.	Within a few units of Kirchhoft's 1255; a peculiar flickering, and frequent changes of brightness.
PIAZZI SMYTH.	Over citron acetylene, at W.L. 5579.
SCHMIDT. (Schellen.)	Varied much in intensity.
ZÖLLNER. (Schellen.)	Brilliant in all parts of the aurora.

No. 3.—*A Line in the Green near E (corona line?)*

ALVAN CLARK, JUN.	At 532; assumed to be 531·6 (corona line).
WINLOCK. (Schellen.)	Notes three lines in the aurora as coincident with corona lines.
LORD LINDSAY.	Near E.; woolly at the edges, but rather sharp in centre; at or near 1474 of the corona.
BACKHOUSE.	Once only, at 532.

No. 4.—*A Line in the Green at or near b*

ELGER.	Very faint; half way between principal auroral line and F.
BARKER.	At 517. (Assumed to be 520.—Winlock.) Nebulous; brightness, 5.
LORD LINDSAY.	A faint band coincident with *b*, and extending equally on both sides of it.
PROCTOR.	A faint band at 57, Na being 32 and $H\beta$ 75, coincident with a line (of oxygen?) in lumière tube.

No. 5.—*A Line in the Green between b and F*

BARKER.	At 502; brightness, 2; conjectured to coincide with a line in the chromosphere.
BACKHOUSE.	Mentions a faint band seen in five auroras out of thirty-eight at 500 or 510 (501?—J. R. C.)

No. 6.—*A Line in the Green-Blue at or near F*

ELGER.	Faint and nebulous.
ALVAN CLARK, JUN.	At 485; assumed to be 486 F hydrogen.
BARKER.	At 482; assumed to be 485 of Alvan Clark, jun.
PROCTOR.	At 81; more refrangible than $H\beta$ (75).
LORD LINDSAY.	Very slightly more refrangible than F; side towards D sharp and well defined; other side nebulous.

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* A line of nitrogen in the air spectrum seems to lie very close to this position, and if other lines lie so near to, or coincide with, those of oxygen and hydrogen, it would appear not unreasonable, until further evidence is obtained, to conjecture that the Aurora Spectrum may be wholly or in part an air spectrum modified by temperature pressure.—J. R. C.

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